



Geographic range extension for the Lobatse Hinge-back Tortoise, *Kinixys lobatsiana* (Power, 1927), with first records from the Soutpansberg region

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Abstract.—The Lobatse Hinge-back Tortoise, *Kinixys lobatsiana* (Power, 1927), has a small distribution range in northern South Africa and adjacent Botswana. Local populations have been fragmented by degradation and destruction of suitable habitat, resulting in this species being listed as Vulnerable by IUCN. Here, the geographic distribution of *K. lobatsiana* is updated and several hitherto unpublished occurrences are reported, which extend its distribution range to the north.

Keywords. Africa, chelonians, geographic distribution, Reptilia, South Africa, Testudinidae

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The Lobatse Hinge-back Tortoise, *Kinixys lobatsiana* (Power, 1927), is near-endemic to northern South Africa. The putative distribution range of this species covers an area of approximately 93,000 km² (extent of occurrence), which mainly falls within the South African province of Limpopo but also extends into the adjacent North West, Gauteng, and Mpumalanga provinces as well as into neighboring south-eastern Botswana (Fig. 1; Hofmeyr and Boycott 2018; Power 1927; TTWG 2017).

In the north, the distribution range was reported to reach to south of the Soutpansberg mountain range (Boycott 2014; Hofmeyr and Boycott 2018), with the sole specimen recorded further north assumed to represent a translocated individual (Boycott 2014; Broadley 1993; Hofmeyr and Boycott 2018; TTWG 2017). The Lobatse Hinge-back Tortoise was described as being closely associated with rocky hillsides and outcrops (Boycott 2014; Boycott and Bourquin 2000; Broadley 1989; Hofmeyr and Boycott 2018) and uses rock crevices and abandoned animal burrows as hiding places (Bonin et al. 2006; Broadley 1989). However, in the frame of the present study the species was also found in open savanna habitats, with only few rocks or burrows, using low shrubs (*Grewia* sp. and *Boscia albitrunca*) for shelter (Fig. 2).

In some of these sites many living tortoises examined had extensive burn marks on their shells, indicating that fires represent a significant threat. While this habitat type is naturally prone to burning, intentional fire as a management tool (e.g., set to stimulate new growth of nutritious vegetation) is often practiced on a higher frequency than natural fires would occur. Thus, higher abundances in rocky habitats might result from a higher survival rate due to the availability of sufficient shelter rather than a real habitat preference.

The species is considered to be the most arid-adapted *Kinixys* (Branch 2008) and was reported from various vegetation types across the central bushveld bioregion. These include dense, short bushveld and thornveld, open tree savannas, *Burkea* savannas, mixed thornveld, and *Combretum* woodlands (Boycott 2014; Branch 2008; Broadley 1989; Hofmeyr and Boycott 2018). *Kinixys lobatsiana* was reported to be absent from highveld grassland and subtropical lowveld (Boycott 2014; Branch 2008; Broadley 1989; Hofmeyr and Boycott 2018). However, we also found the species in a mosaic of highveld grassland and Loskop mountain bushveld in the Ezemvelo Nature Reserve. Degradation and destruction of suitable habitat have been identified as the main

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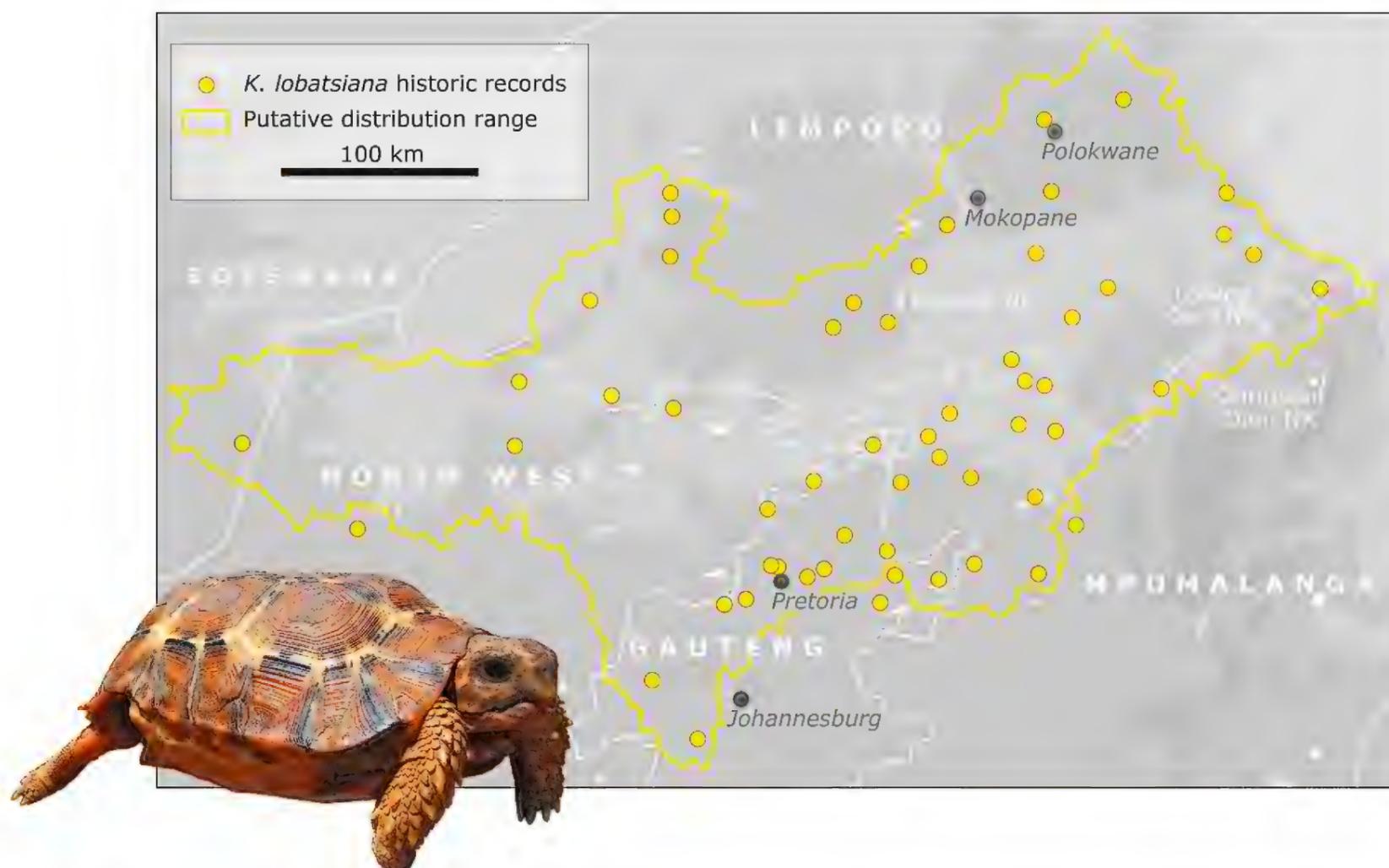


Fig. 1. Putative range of the Lobatse Hinge-back Tortoise (*Kinixys lobatsiana*) according to TTWG (2017), with historic records compiled from scientific collections. Inset: *K. lobatsiana* from the Lapalala Wilderness Reserve. Photo by Flora Ihlow.

threats for *K. lobatsiana*. While land use varies, habitat transformation is considered particularly severe in north-eastern South Africa and Botswana, where approximately 20–25% of suitable habitat has been destroyed within the last four decades, and a loss totalling 35–40% is expected within the next 30–40 years (Hofmeyr and Boycott 2018). Intact habitat appears to be fragmented and is largely restricted to protected areas and private reserves. Consequently, the IUCN conservation status of *K. lobatsiana* has recently been elevated from Least Concern to Vulnerable (Hofmeyr and Boycott 2018).

Here, the geographic distribution range of the species is discussed based on genetically verified records, and several occurrences are reported that considerably extend its known range. Field research was conducted across most of the South African distribution range of *K. lobatsiana* as well as at selected sites containing suitable habitat outside of its known range. Study sites were selected by geo-referencing collection sites of museum specimens mentioned by Broadley (1989, 1993) and other published records (TTWG 2017). The dataset was supplemented with selected observations (i.e., those where photographic vouchers allowed species identification) from the ReptileMap database (FitzPatrick Institute of African Ornithology 2019; <http://vmus.adu.org.za>). Searches for *K. lobatsiana* were carried out during the species' daily activity times and suitable weather conditions. GPS coordinates were collected for each individual. All tortoises were identified based on established morphological traits and coloration patterns (Broadley 1993), measured, and photographed from several angles.

In addition, a small (0.2 ml) blood sample was drawn from the subcarapacial sinus using a 1 ml syringe and a 25-G needle for genetic verification of species identification. Blood samples were either preserved using Whatman paper (GE Healthcare, Munich, Germany) or in analytical ethanol, and subsequently processed at the molecular genetic laboratory of the Museum of Zoology, Senckenberg Dresden, Germany. Species identification was genetically verified using mtDNA fragments containing the *cyt b* gene or the partial ND4 gene plus adjacent DNA coding for tRNAs following methods outlined in Kindler et al. (2012). European Nucleotide Archive (ENA) accession numbers of voucher sequences for extralimital records are listed in Table 1.

The following hitherto unreported occurrences extend the range of the species in two regions to the north, namely in the northern Waterberg region and the western Soutpansberg area (Fig. 2). Sampling sites in the Waterberg region include the Lapalala Wilderness Reserve, covered by a vegetation type classified as Waterberg mountain bushveld (Dayaram et al. 2017), and the private Kudu Canyon Reserve (central sandy bushveld; Dayaram et al. 2017) located in the vicinity of the Mokolo Dam Nature Reserve. Sites in the western Soutpansberg area comprise Sigurwana and the neighboring Goro Game Reserve (Soutpansberg mountain bushveld; Dayaram et al. 2017; Table 1). The Leshiba Wilderness and the Medike Nature Reserve neighboring Sigurwana in the east provide similar high-altitude habitat, but harbor *K. spekii* instead of *K. lobatsiana*. However, additional searches targeting high elevation habitat in the Medike Nature Reserve will

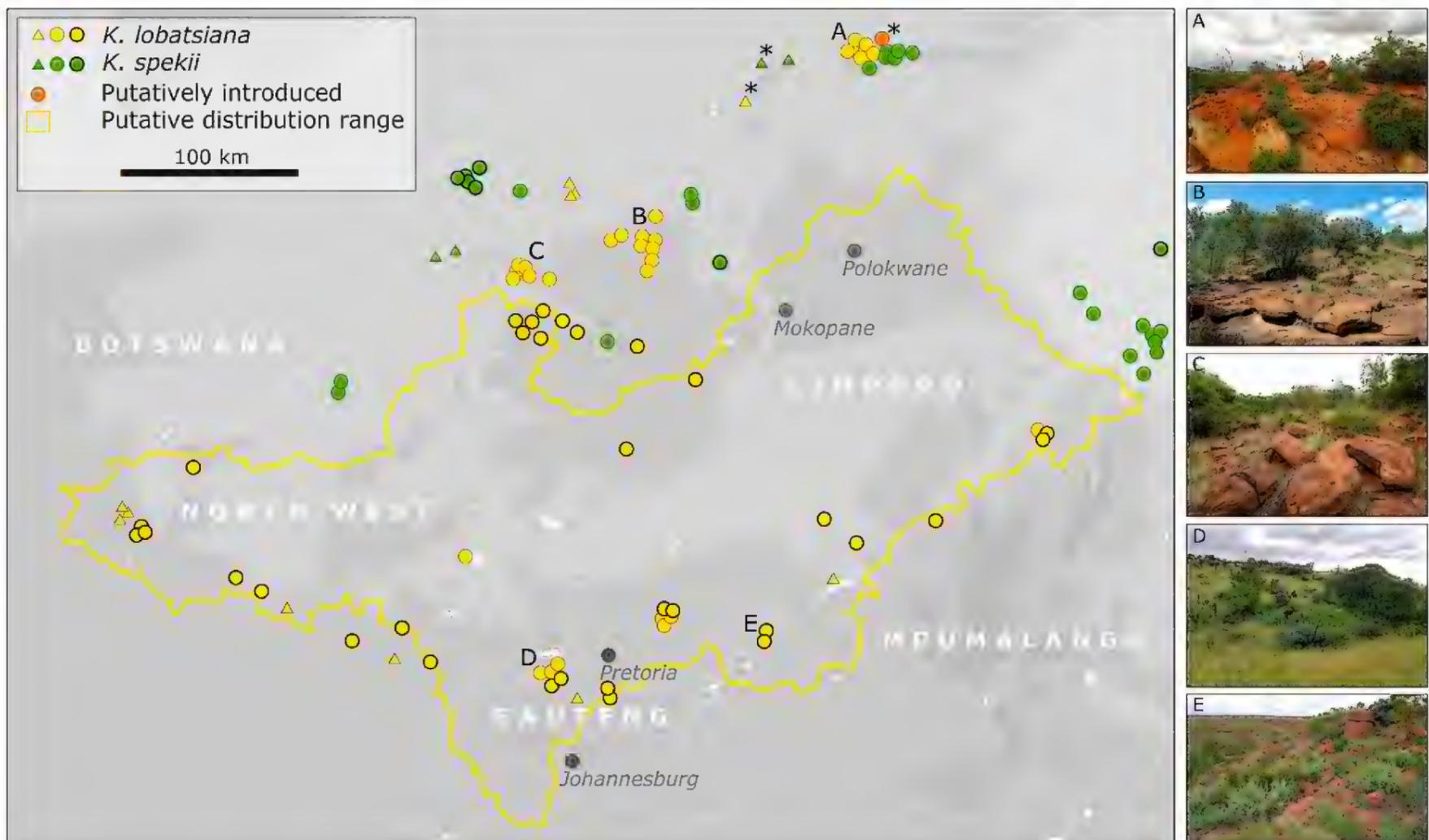


Fig. 2. Distribution range of the Lobatse Hinge-back Tortoise (*Kinixys lobatsiana*) according to TTWG (2017), with genetically confirmed range extensions (dots), not yet processed samples (dots with bold black outline), and recent observations (triangles). Observations marked with an asterisk refer to collection material in the Ditsong National Museum of Natural History (TM 36366, TM 67909, TM 79431). Right: Characteristic habitats from different parts of the distribution range. Photos by Flora Ihlow.

be required to fully clarify the distributions of *K. spekii* and *K. lobatsiana* in this area. The samples reported here, published records, and museum specimens consistently suggest that *K. spekii* also inhabits the surrounding lowlands (Schmidt 2002).

Only a few herpetological surveys have been previously conducted within the Soutpansberg Mountain Range (e.g., SARCA surveys contributing to Bates et al.

2014; Jacobsen 1989; Kirchhof et al. 2010). Most studies either targeted areas covered with habitat unsuitable for *K. lobatsiana* or focused on taxa with considerably different activity profiles. As a result, *K. lobatsiana* has not been recorded from the area thus far, except for a single record from north of the Soutpansberg mountains that was considered to refer to a misplaced individual (Broadley 1993; Hofmeyr and Boycott 2018; TTWG

Table 1. Records extending the distribution range of the Lobatse Hinge-back Tortoise (*Kinixys lobatsiana*) to the north. Coordinates obscured to protect populations against poaching. ENA = European Nucleotide Archive; MTD T = Museum of Zoology, Senckenberg Dresden (Tissue Collection).

MTD T	ENA number	Study site	Latitude	Longitude	Elevation
17056	LR746292	Lapalala Wilderness Reserve	-23.8	28.3	1,160 m
17062	LR746293	Lapalala Wilderness Reserve	-23.8	28.3	1,160 m
17064	LR746294	Lapalala Wilderness Reserve	-23.8	28.3	1,100 m
17067	LR746295	Lapalala Wilderness Reserve	-23.8	28.3	1,040 m
17071	LR746296	Lapalala Wilderness Reserve	-23.7	28.3	1,100 m
17076	LR746297	Lapalala Wilderness Reserve	-23.8	28.2	1,060 m
17078	LR746298	Lapalala Wilderness Reserve	-23.9	28.3	1,160 m
17079	LR746299	Lapalala Wilderness Reserve	-23.9	28.3	1,140 m
20164	LR746300	Kudu Canyon	-24.0	27.7	1,009 m
20169	LR746301	Kudu Canyon	-24.0	27.7	930 m
20176	LR746302	Goro Game Reserve	-22.9	29.4	1,086 m
20188	LR746303	Sigurwana	-22.9	29.4	1,380 m
20189	LR746304	Sigurwana	-22.9	29.4	1,360 m
20738	LR746305	Sigurwana	-22.9	29.4	1,380 m
20739	LR746306	Sigurwana	-22.9	29.4	1,440 m



Fig. 3. Lobatse Hinge-back Tortoise (*Kinixys lobatsiana*, TM 36366) collected at Rochdale Farm, Waterpoort, from the Ditsong National Museum of Natural History. Photo by Adriaan Jordaan.

2017). This record likely corresponds to a museum specimen housed at the Ditsong National Museum of Natural History (TM 36366) collected in 1964 by G. Newlands on Rochdale Farm, Waterpoort. Rochdale Farm lies on the northern slope of the Soutpansberg, just east of Waterpoort. A morphological examination of TM 36366 confirms that it represents *K. lobatsiana* (Fig. 3). Broadley (1993) suggested that this specimen might have been “swept through the gorge by the Sand River during a flood” to reach its collection site, while Boycott (2014) added translocation by humans as another possible explanation. Considering that *K. lobatsiana* is confirmed from two other properties on the northern slope of the Soutpansberg Mountains, 22 km away from the collection site of TM 36366, that record no longer appears to be an outlier. The present evidence rather suggests a continuous distribution of *K. lobatsiana* along the northern slope of the western Soutpansberg.

Schmidt et al. (2005) reported *K. spekii* from the Blouberg Nature Reserve. Unfortunately, this finding could not be re-examined because neither access to the reserve nor photographs of the tortoise could be obtained so far. However, a specimen in the Ditsong National Museum of Natural History (TM 67909) collected from a farm located approximately 6 km west of the Blouberg Nature Reserve (The Glen, Quarter Degree Square 2328Bb) morphologically resembles *K. spekii*. In addition, two photo vouchers (163852 and 167289), uploaded to the virtual museum database (<http://vmus.adu.org.za>) showing the same individual from the southern lowlands of the Blouberg Nature Reserve, also resemble *K. spekii*. However, another specimen from

the Ditsong National Museum of Natural History (TM 79431) collected at Bochum, Limpopo (QDS 2329AC), morphologically resembles *K. lobatsiana*. Thus, further research is needed to clarify the distributions of these two species in this area.

The present report shows that the distributions of *K. lobatsiana* and *K. spekii* are still incompletely known. This contradicts Branch et al. (1995), who concluded that the distribution of South African tortoises and terrapins is relatively well-documented. Misidentifications of these two morphologically challenging species and the application of an outdated taxonomy compromise the previous assessments of their distributions. *Kinixys lobatsiana* and *K. spekii* were lumped together with other species under “*K. belliana*” before Broadley (1989, 1993) separated these taxa.

While Broadley (1993) stated that for *K. lobatsiana* no evidence of sympatry with any other species exists, later authors considered *K. lobatsiana* to co-occur with *K. spekii* throughout its range (TTWG 2017). However, only a few areas (Waterberg region, western Soutpansberg) were found where both species occur in close proximity. Juveniles and old specimens of both species tend to lack the characteristic shell shape and color patterns used to distinguish between the two species (Broadley 1993), which leads to high misidentification rates, compromises range estimates, and has implications for conservation measures that are based on erroneous records and range estimates (Figs. 4–5; Ihlow et al. 2019).

The most reliable morphological trait to distinguish challenging adult specimens of *K. spekii* and *K. lobatsiana* is the serrated posterior carapace rim in the latter species



Fig. 4. Top: Juvenile Lobatse Hinge-back Tortoise (*Kinixys lobatsiana*, SCL = 81 mm) from Sigurwana, western Soutpansberg, Limpopo. Bottom: Young Speke's Hinge-back Tortoise (*K. spekii*, SCL = 106 mm) from Leshiba Wilderness, western Soutpansberg. Scale bar: 1 cm. Species identification of both tortoises was genetically confirmed. Photos by Flora Ihlow.

(Ihlow et al. 2019). However, this character does not always suffice in juveniles (Fig. 4). To enable later re-examination, photographs should document the dorsal, ventral, and lateral aspects of each tortoise. In addition, molecular genetic confirmation is recommended.

Branch et al. (1995) concluded that most South African chelonian species are adequately protected by existing reserves. However, he stressed that *K. lobatsiana* was only recorded in three major reserves, namely the Loskop Dam Nature Reserve (Mpumalanga), the Ohrigstad Dam Nature Reserve (Mpumalanga), and the Nylsvley Nature Reserve (Limpopo). The species could be confirmed from a photo voucher taken by an employee of the Loskop Dam Nature Reserve in 2017, but records from the other two reserves have to

be considered uncertain. Only a single possible record exists for the wider Ohrigstad area (Ditsong National Museum of Natural History, TM 21329, a specimen closely resembling *K. lobatsiana*, collected by P. van Tonder in 1944). However, the Ohrigstad Dam Nature Reserve itself is located well outside of the putative range of the species. In the Nylsvley Nature Reserve, "*K. b. belliana*" was reported from a single photographed tortoise (Jacobsen 1977), which was identified as *K. lobatsiana* by Broadley (1993), but Jacobsen (2008) referred to the same record later as "*K. belliana spekei* [sic]", suggesting that *K. spekii*, and not *K. lobatsiana*, occurs in the Nylsvley Nature Reserve. Unfortunately, no hinge-back tortoise has been recorded there for many years by the local rangers (pers. comm.) nor are there any



Fig. 5. Speke's Hinge-back Tortoise (*Kinixys spekii*) from the vicinity of Vaalwater (left) and Lobatse Hinge-back Tortoise (*K. lobatsiana*) from the Lapalala Wilderness Reserve (right) with very similar color patterns. Species identification of both tortoises was genetically confirmed. Photos by Flora Ihlow.

photographs of hinge-back tortoises from this reserve in any of the databases that were queried. Branch et al. (1995) further highlighted the Marakele National Park (former Kransberg National Park) and the Blyde River Canyon Nature Reserve as important statutory protected areas where the species has been recorded. However, we are not aware of any contemporary records from either of these reserves. In addition to these published localities, the occurrence of *K. lobatsiana* from the following sites was confirmed:

Gauteng: Ezemvelo Nature Reserve (Bronkhorst-spruit), Irene, Kalkheuwel, Leopard Lodge (Thiane Wildlife Sanctuary), Monateng Safari Lodge (East Lynne).

Limpopo: Bushfellows Lodge (Marble Hall), Goro Game Reserve (Western Soutpansberg), Inkwe Private Nature Reserve (Waterberg), Kalkfontein Farm (Groblersdal), Kudu Canyon Farm (Lephalale), Lapalala Wilderness Reserve (Waterberg), Lépelle Lodge (Burgersfort), Sigurwana Lodge (Western Soutpansberg), Thandabantu Game Lodge (Roos-senekal), Welgevonden Nature Reserve (Waterberg).

Mpumalanga: Loskop Dam Nature Reserve.

North West: Kgaswane Nature Reserve (Rustenburg), Koster (Rustenburg), land owned by the Bahurutshe Ba Ga Lencoe Traditional Council (Moshana village), Riekersdam Farm (Ramotshere Moiloa), Tswenyane Safaris (Zeerust), Vaalkop Dam Nature Reserve (Rustenburg).

While the species appears to be rare in most areas, larger populations were recorded in the Waterberg area (Lapalala Wilderness Reserve, the Welgevonden Nature Reserve, and in the vicinity of the Mokolo Dam Nature Reserve), in the vicinity of Kalkheuwel, and in the vicinity of Lobatse, Botswana.

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NW6124/10/2018, and Gauteng: CPF6-0210. Field research was partly funded through the Mapula Trust awarded to Margaretha D. Hofmeyr. Flora Ihlow profited from a Margarethe Koenig Scholarship of the Zoological Research Museum Alexander Koenig and is currently supported by the German Science Foundation (DFG IH 133/1-1).

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Flora Ihlow is a German herpetologist (Dr. rer. nat.) presently working at the Senckenberg Natural History Collections, Dresden, Germany. For the past 10 years, Flora's research predominantly focused on the ecology, systematics, and distribution of Southeast Asian chelonians. She has published numerous scientific papers on the herpetofauna of Southeast Asia. After her graduation from the Rheinische Friedrich Wilhelms University (Bonn, Germany), Flora joined the phylogeography department of Senckenberg, Dresden in 2017 to work on the systematics and distribution of chelonians from southern Africa within the frame of a post-doctoral position. Flora is a member of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group (TFTSG).



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Dawn Cory-Toussaint is currently a final year Ph.D. student at the University of Venda (South Africa) studying the ecological impacts of opencast diamond mining on bats and the role that bats can play as biological indicators in Limpopo. Dawn has a broad understanding and an unlimited interest in the natural world. She has been involved in projects on diverse organisms ranging from Killer Whales (satellite tagging and biopsy sampling) to beetles (Darkling Beetles of the Bushveld). Being involved in projects that are broader than her current study, particularly in northern Limpopo, is invaluable to her role in the management and conservation in the area where she currently resides and works.



Margaretha D. Hofmeyr was Professor Emerita at the Biodiversity and Conservation Biology Department, University of the Western Cape, South Africa. She was an ecophysiological by training and first studied large ungulates before switching to chelonians. Her ecophysiological studies revealed that South African tortoises have many unique characteristics, which stimulated her interest in their genetic diversity and systematics. Margaretha published extensively on the ecology and phylogeography of sub-Saharan tortoises and turtles, and she was closely involved in conservation projects on threatened tortoises. This work resulted in her being awarded the 2015 Sabin Turtle Conservation Prize. She was a member, and Regional Vice-Chair for Africa, of the IUCN/SSC TFTSG and coordinated the 2014 and 2018 Red List Assessment for South African tortoises and freshwater turtles.



Uwe Fritz is the head of the Museum of Zoology, Senckenberg Natural History Collections in Dresden, Germany, and Extraordinary Professor for Zoology at the University of Leipzig, Germany. Uwe has worked for many years on the taxonomy, systematics, and phylogeography of turtles and tortoises, and has also studied to a lesser extent snakes and lizards. He is particularly interested in hybridization patterns and gene flow in contact zones of distinct taxa. Uwe has authored or co-authored numerous scientific articles, mainly in herpetology, and has also edited proceedings and books, among them the two turtle volumes of the *Handbook of Amphibians and Reptiles of Europe*.